SOIL SURVEY OF JACKSON COUNTY, MISSOURI.

By A. T. SWEET, of the U. S. Department of Agriculture, and H. KRUSEKOPF and J. E. DUNN, of the University of Missouri.

DESCRIPTION OF THE AREA.

Jackson County is located on the western border of Missouri, slightly north of the median line. It is bounded on the north by the Missouri River, on the east by Lafayette and Johnson Counties, on the south by Cass County, and on the west by Johnson County, Kans. It is almost square, the east, south, and west boundaries being straight

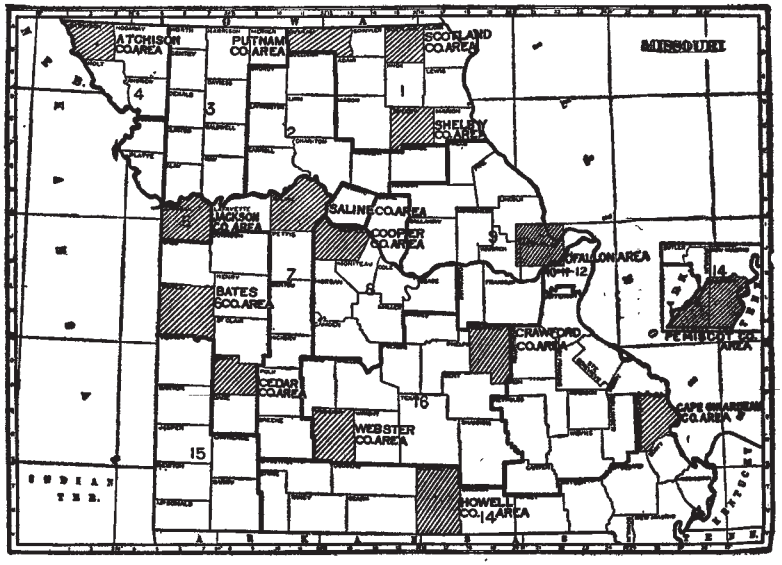

FIG. 34.—Sketch map showing location of the Jackson County area, Missouri.

lines. Its width from east to west is 27 miles and its maximum length from north to south practically the same. It contains 607 square miles, or 388,480 acres.

The topography, considering the county as a whole, is rather rough as compared with many counties of the western prairie region, though areas of considerable extent are comparatively level and others are gently undulating.

The elevation of the Missouri River flood plain is about 740 feet in the eastern part of the county and 760 in the western part, while the high ridge on which Lees Summit stands is about 1,090 feet above

sea level. The highest part of the county is near the southwestern corner. From this part it slopes gently northwestward to the vicinity of Kansas City, where the elevation is about 1,000 feet.

The greater part of the county is a plain, cut rather thoroughly by valleys. The only variation from this simple topography is a small area in the northeastern corner, where a lower and more gently undulating plain has been developed on the soft shales that lie below the heavy limestone beds supporting the higher upland plain of the county. This tract lies from 100 to 150 feet below the adjacent upland. Its main body occupies the eastern parts of Sniabar and Fort Osage Townships. Its southern boundary lies along the foot of the hills just south of the Chicago & Alton Railroad from Oak Grove to the vicinity of Blue Springs. Thence the boundary runs to the northeast about 5 or 6 miles, swings northward about 2 miles, and then north, continuing northwest by north to Sibley. Along its southern boundary it runs up the valleys of the streams flowing out of the higher upland in broad, picturesque, covelike valleys. Similar valleys are developed to a slight extent along the Little Blue in a few places.

This area is an undulating to rolling plain. The rest of the county is a high plain, smooth along the watersheds, but in places cut by valleys. The largest area of high, smooth plain lies in the vicinity of Lees Summit. This forms part of the main watershed of the county and from it run high watershed ridges eastward to Hicks City and northward by Blue Springs, to the point where the upland drops to the lowland plain level 5 miles northeast of Grain Valley. Another tonguelike ridge extends northward from the main watershed between Big Blue and Little Blue Rivers to the Missouri north of Independence. Kansas City lies at the northern end of another ridge entering from Kansas and lying between the Kaw and Big Blue Rivers. Working back into these ridges and into others which are not so high are many streams, which, with their numerous small tributaries and almost innumerable smaller feeders, reach into every part of the area.

The fringe of high plain adjacent to the outer boundary of the lower upland plain is thoroughly dissected, giving rise to a belt of rough country. Abundant outcrops of rather heavy beds of limestone accentuate the roughness. The larger streams that drain the high upland plain are also bordered by belts of rough country.

The creek bottoms, taken as a whole, are rather narrow, especially when compared with those occupied by streams of equal size in the counties lying east and southeast of Jackson County. This is especially true of the valleys in the high plain. The valley of Sniabar Creek after it enters the undulating lower country near Grain Valley is wider, approximating the valleys of counties farther east. Buck-

ner, Levasy, and Lake City all lie in a broad valley unoccupied at present by any stream large enough to have made it. It opens into the Little Blue Valley at one end and into the Missouri Valley at the other. It is probably an abandoned valley of the Little Blue, one that was occupied by that stream before taking a more direct course northward into the Missouri as it does at present.

Very little of the Missouri bottom land lies in Jackson County. The river flows close to the bluffs on the south, leaving most of the bottom land on the north side of the river in Clay and Ray Counties.

The western part of the county is drained by the Big Blue River, the central and larger part by the Little Blue River, and the eastern part by Sniabar Creek. Each of these streams has a flood plain varying in width from only a few rods to a mile or more, and each is bordered by rather steep rocky bluffs on one and in some places on both sides. A small portion of the drainage in the northern part of the county flows directly into the Missouri River, while a small area in the southeastern part drains into Big Creek, a tributary of Grand River. No portion of the uplands lacks sufficient fall for good surface drainage.

Two abandoned valleys of interest are found in this area. The smaller extends across Kansas City from near the point where Turkey Creek enters the Kaw to Sheffield, in the valley of the Big Blue. This is an old valley of Turkey Creek, which stream formerly entered the Big Blue, but through its own work and that of the Kaw in cutting away the narrow bluff separating them, found a shorter route to the Missouri.

The second abandoned valley extends from a point two miles southwest of Lake City to the Missouri River bottoms near Levasy. This apparently is a former valley of the Little Blue River, which was probably diverted from that course to its present one by a small tributary of the Missouri. There are evidences, however, that a portion of the Missouri at some time flowed through this valley. In several places elongated mounds and ridges occur, containing much sand unlike any found in the upper course of the Little Blue. These may have been deposited during some high stage of the Missouri or may possibly be of glacial origin.

The first permanent white settlements in Jackson County were made in the Six Mile Country surrounding Fort Osage, established on the present site of Sibley in 1808. No settlements of importance were made until the Indians in 1825 relinquished their claims to the Twenty-four Mile Strip, which included practically all of Jackson County.

The county was organized in 1826, the larger number of the settlers coming originally from Virginia, the Carolinas, and Tennessee.

The population, according to the census of 1910, including Kansas City, was 283,522.

In 1827 Independence was founded and until 1840 appeared to be the future great city of the West. Then trade began to center at Westport, which was founded in 1833, and for a time that was the leading town. The original town site of Kansas City, at the junction of the Kaw and Missouri Rivers, consisting of 320 acres, was purchased in 1838 for $4,220 and laid out in town lots. For a long time Kansas City was the outpost on the boundary of the Great Plains. It was also near the junction of two rivers, over which was carried the principal business of this part of the country. When the overland trails to Santa Fe and Salt Lake and later to California were opened up this place became the natural outfitting point. Later still, when steamboats and ox teams were supplanted by railroads, the natural routes from the East to the West lay along the same lines.

Almost from the beginning Kansas City had a steady and rapid growth. According to the census of 1910 it had a population of nearly 230,000. Westport long ago became a part of Kansas City, and while Independence still maintains its separate municipal organization it is practically a suburb, and its incorporation as a part of Kansas City is only a question of time. The population of Kansas City and of the remainder of the county is rapidly increasing. Besides Kansas City and Independence, other railroad towns of importance are Lees Summit, Blue Springs, Oak Grove, Buckner, Greenwood, and Grandview. Sugar Creek and Mount Washington are located between Independence and Kansas City. Other smaller places are Grain Valley, Courtney, Levasy, Atherton, Sibley, Martin City, Dodson, and Lonejack.

Kansas City is entered from Missouri by 16 lines of railroad, a large number being trunk lines. Three lines cross Jackson County from east to west and five from north to south. Independence and Dodson are connected with Kansas City by electric lines, while other lines extend from Kansas City to Olathe and Leavenworth, Kans.

Jackson County has a splendid system of macadam roads, which connect every town in the county with Kansas City. The extent and location of these roads may be seen on the accompanying soil map.

CLIMATE.

The climate of Jackson County differs but slightly from that of other parts of central and northern Missouri. The annual mean temperature is slightly lower both in winter and summer and the average annual rainfall slightly less than in the eastern and central parts of the State. On the other hand, the period between the average date of the last killing frost in spring and the first killing frost in autumn is slightly longer.

The following table, compiled from records of the Weather Bureau, shows the normal monthly, seasonal, and annual temperature and precipitation at Kansas City:

Normal monthly, seasonal, and annual temperature and precipitation, at Kansas City, Mo.

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.	Snow, average depth.
	°F.	°F.	°F.	Inches.	Inches.	Inches.	Inches.
December	34	70	−13	1.4	1.7	1.4	4.7
January	30	69	−17	1.3	.4	4.1	5.6
February	29	76	−22	1.8	1.4	1.1	8.0
Winter	31			4.5	3.5	6.6	18.3
March	41	88	2	2.5	3.7	4.5	4.1
April	56	90	22	3.0	4.2	3.8	1.0
May	65	90	36	5.1	.8	7.7	.0
Spring	54			10.6	8.7	16.0	5.1
June	74	100	48	4.4	2.5	6.0	.0
July	78	106	54	5.0	2.8	4.9	.0
August	76	103	46	4.0	2.6	5.0	.0
Summer	76			13.4	7.9	15.9	.0
September	69	101	35	3.9	1.8	4.5	.0
October	58	91	26	2.3	2.2	4.4	.4
November	43	79	4	1.7	.6	2.7	1.3
Fall	57			7.9	4.6	11.6	1.7
Year	54	106	−22	36.4	24.7	50.1	25.1

From the above table it will be noted that the mean annual precipitation is 36.4 inches, and that the average for the months from April to September is more than twice as much as for the remaining months of the year. The rainfall is ample, however, if proper means are taken to conserve the moisture, to produce large yields of all crops grown in the area.

The average date of the last killing frost in spring at Kansas City for a period of 20 years is April 10, and of the first killing frost in autumn October 23, making an average growing season of 195 days. This is sufficiently long for practically all crops grown in the area. Fruit, while sometimes injured by heavy frosts following periods of warm weather in late winter or early spring, is rarely an entire failure. Two or more crops of vegetables are raised on the same ground in the truck gardens, and the climate, as a whole, is well suited to general farming.

AGRICULTURE.

In a report to the secretary of the State board of agriculture made in 1873, D. I. Caldwell, superintendent of public schools of Jackson County, says:

> The soil is a rich alluvial loam, producing in abundance all the cereals, the finest hemp, flax, and tobacco, and all kinds of vegetables. * * * The leading agricultural staples are wheat, corn, oats, and grasses of different varieties, all of which grow well in our soils. * * * In fact, there is scarcely anything in the vegetable kingdom, suited to our latitude, that does not find a congenial soil in Jackson County. * * * Blue grass, orchard grass, redtop, Hungarian millet, clover, and timothy are all used.[1]

With but few changes these statements are still applicable to the agricultural conditions in Jackson County. Hemp is the only crop which must be dropped from the list, while flax and millet are raised to only a limited extent. For many years tobacco was grown for home use only, but recently its production on a commercial basis has been revived, and it is rapidly becoming, in parts of the county, an important crop. Some new crops have also been introduced, the most important of which are alfalfa and cowpeas. Cut flowers, nursery stock, garden truck, small fruit, and melons are grown to an extent unheard of 30 or 40 years ago.

The agriculture of the county as a whole consists of general farming combined with stock raising. In value of its live stock Jackson County ranks third in the State, being second in the production of cattle and third in the production of sheep, jacks, and stallions. Much pure-bred stock of all kinds is kept.

In the northern part of the county wheat and clover are the principal crops, while in the central and southern parts larger areas are devoted to pasture and more stock is handled. This is due in part to differences in soil, but also to the settlement of the loess soils by Germans, who are to a large extent grain farmers.

The following charts show the crops grown on two widely separated portions of the county for the year 1910, Chart I from the vicinity of Sibley being fairly representative of the loess soils, while Chart II from the vicinity of Lees Summit is fairly representative of the prairie residual soils.

It will be noted that in Chart I, 32 per cent of the land is devoted to small grains, while in Chart II only 12 per cent is devoted to these crops. These data are not strictly comparable, however. In small grains wheat, oats, and rye are included. Of these, wheat is by far the most important, occupying nearly three-fourths of the area devoted to small grains. The percentage of oats, however, appeared larger in Chart II than in Chart I. The area devoted to pasture in

[1] Eighth Annual Report Missouri State Board of Agriculture, 1873, p. 307.

Chart I includes several areas of brush, partly timbered, and in sections 13, 14, and 15 some wet and poorly drained areas of wild grasses. In Chart II the pasture consists almost entirely of blue-

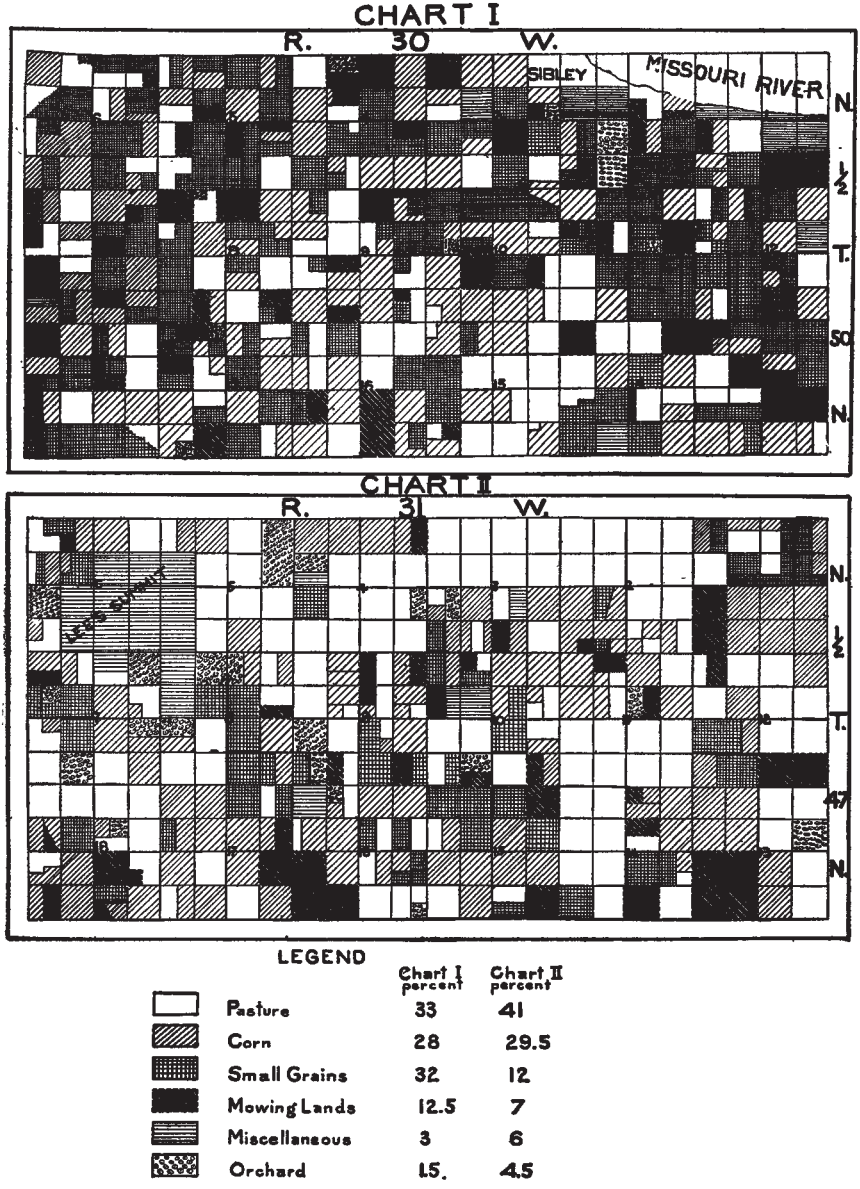

FIG. 35.—Comparative acreage of crops grown on loess and on shale soils, 1910. Chart I, loess soils; Chart II, shale soils.

grass, white clover, and timothy. The mowing land in Chart I is almost exclusively clover or clover and timothy, while in Chart II a

larger proportion of it consists of timothy with some redtop and other grasses. The area devoted to orchards in Chart II is three times as much as that devoted to orchards on the much better fruit soil in Chart I.

The estimated production of the principal farm crops for Jackson County for 1910 is as follows:

Estimated production of wheat, corn, oats, and hay and forage crops for Jackson County, Mo., 1910.[1]

Crop.	Acreage.	Average yield.	Total for county.
Wheat	19,736	15 bushels	296,040 bushels.
Corn	106,540	35 bushels	3,728,900 bushels.
Oats	6,490	35 bushels	227,150 bushels.
Hay and forage	42,069	1.6 tons	67,310 tons.

[1] Missouri Crop Review for December, 1910, bulletin Missouri State Board of Agriculture.

The extent of additional important farm, garden, and orchard products of the county is shown by the following table, furnished by the Bureau of Labor Statistics, for the year 1909:

Amount of important farm, garden, and orchard products of Jackson County, Mo., sold or consumed at home, for the year 1909.[1]

Crops.	Yield.	Crops.	Yield.
Farm crops:		Fruits and melons:	
Clover seed....bushels..	2,640	Strawberries....crates..	15,000
Timothy seed....do....	5,380	Apples....barrels..	9,763
Tobacco....pounds..	24,000	Cantaloupes....crates..	12,000
Bluegrass seed....do....	35,600	Grapes....baskets..	12,500
Planting and garden seeds..do....	3,200	Melons....	15,750
Vegetables:		Peaches....baskets..	3,000
Assorted cucumbers....do....	1,365,000	Nursery stock....pounds..	675,000
Sweet potatoes....bushels..	7,000	Cut flowers....do....	35,000
Potatoes....do....	47,000		
Mushrooms....pounds..	25,000		
Tomatoes....bushels..	67,000		
Onions....do....	31,000		

[1] Surplus products of Missouri counties, 1910. Compiled by the Bureau of Labor Statistics.

The number of live stock for the same year was estimated as follows:

Estimated number of farm animals in Jackson County, 1909.

Farm animals.	Number.
Cattle	42,116
Hogs	73,109
Horses and mules	4,472
Sheep	36,360

The estimated total value of the principal farm commodities was as follows:

Value of farm products for Jackson County, 1909.

Product.	Value.	Product.	Value.
	Dollars.		*Dollars.*
Live stock	3,126,880	Vegetables	361,775
Poultry, eggs, etc	1,684,553	Fruit	172,259
Farm crops	819,161	Flowers and nursery products	51,250
Dairy products	721,700		

Recently letters were sent to a number of Jackson County farmers asking for a statement of the yield of corn, wheat, and oats on their farms for the last 10 years, the varieties grown, whether yields are increasing, stationary, or decreasing, other crops produced, the amount of stock handled, the kinds of green fertilizers used, and the rotation followed on some particular field for the last 5 years. Forty-three per cent of these letters were answered very fully. They show that the estimated average yield of corn for the last 10 years is 42.07 bushels per acre. Of those farmers sending replies 59 per cent believe the yield is increasing, 33 per cent declare it to be stationary, and 8 per cent believe it is decreasing. The principal varieties are Reids Yellow Dent, Golden Beauty, Boone County White, Iowa Silver Mine, Jumbo King, and Long John.

The estimated average yield of wheat for the decade is 18.78 bushels per acre, and 51 per cent believe the yield is increasing, 34 per cent believe it is about stationary, and 14 per cent believe it is decreasing. The principal varieties are Fultz, Harvest King, Harvest Queen, Bluestem, Lancaster, and Red Cross.

Over 73 per cent of these farmers plow under clover for green manure, and nearly 15 per cent use manure spreaders.

The principal crop rotations are corn for two or three years, followed by oats or wheat, or in some cases by both, the wheat usually after the oats. The small grains are succeeded by clover or clover and timothy for two years or more. Over 31 per cent are growing or attempting to grow alfalfa. Only 2 per cent are growing cowpeas.

These letters, while indicating a very desirable condition agriculturally, are slightly misleading, owing to the fact that a majority of the farms reported are located on the better areas of the soil represented, and the yields are thus somewhat higher than the average for the type. The farmers, too, are probably men of more than average ability.

The crop rotations shown by these letters are fairly typical of the county as a whole, although in some sections the tendency is to produce corn on the same ground for more than two years. If the soils are to be maintained in a high state of productiveness not more than two corn crops on the strongest soils and one on the eroded and poorer soils will, in the long run, prove most profitable. Where manure is available it should be applied uniformly over the entire field, at a definite place in the crop rotation, usually preceding corn. This can be done most satisfactorily by the use of manure spreaders.

Through an extensive use of clovers the soils of a large part of the county have been kept in a fair state of productiveness, but there is room for much improvement. Not only should clover be used more extensively than it is, but cowpeas should also be grown. At present this crop, although one of the best suited to this region for building up the soil, is receiving but little attention. Cowpeas may be planted in the corn at the last plowing, may be sown immediately after a crop of wheat is cut, or may follow a crop of oats which is cut early for hay. When used in this way they can be pastured or plowed under green. If intended for hay or for seed they may follow corn or any spring crop which can be removed by June 15. Cowpeas should not supplant clover, especially where it thrives, as it does in the greater part of Jackson County, but should be used to supplement it. On the black and yellowish soils in the southern parts of the county where less clover is grown they should prove especially valuable.[1]

Alfalfa is receiving considerable attention in Jackson County with varying results. Best suited to this crop are the yellowish-brown loess soils of the northern part of the county, mapped as Knox silt loam, and the lighter alluvial silt loams of the stream valleys when they are well drained. Alfalfa, however, is adapted to a wide range of soils, the principal requirements being a deep, fertile, well-drained soil of good tilth and having a fairly open subsoil. The greater proportion of the better soils of all types in Jackson County meet these requirements, and alfalfa can be grown on any of them if the proper care is taken to enrich the ground, to eradicate weeds and grass before sowing, to prepare the seed bed properly, and to persist in spite of one or more failures until a good stand is obtained. Alfalfa yields three and sometimes four cuttings of from three-fourths to over a ton per acre at each cutting.[2]

[1] Farmers' Bulletin No. 318, U. S. Dept. Agr., Circular No. 39, The Seeding of Cowpeas, Missouri Experiment Station, and growing Cowpeas in Missouri, issued by the State Board of Agriculture, give valuable suggestions on growing this crop.

[2] See Farmers' Bulletin No. 339, U. S. Dept. Agr., and Circular No. 40 and Bulletin No. 72 issued by the Experiment Station, Columbia, Mo.

Corn growing is receiving considerable attention in all parts of the county and the yields are increasing. This is due to the use of a rotation in which corn is grown on the same ground for not more than two years in succession, to the plowing under of clover, the more careful and systematic use of manure, the improvement of seed, the better preparation of the seed bed, and more thorough cultivation. By attention to these details the yields can be still further increased.[1]

Although wheat is an important crop in Jackson County much less attention has been paid to its improvement than to the improvement of corn. As a result the yields have remained about stationary or show only a slight increase. With a thorough preparation of the seed bed; careful control of smut and the Hessian fly, and by more care in selecting and cleaning the seed the yields of wheat can undoubtedly be increased. Commercial fertilizers can also be used with profit on some of the wheat lands.[2]

Oats in Jackson County, as in other parts of Missouri, have not been a very profitable crop for several years past on account of injury from rust. Through the introduction of hardier varieties better results are being obtained. About 75 per cent of the farmers answering the letters of inquiry grow oats, and of these over half sow the Texas Red. The next most popular variety is Early Harvest. The average yield reported by these farmers is 40 bushels to the acre. The station at Columbia has found through experiments that by treating seed oats with a formalin solution to eradicate the smut the yield can be increased from 5 to 20 per cent.

From 20 to 30 years ago plantings of apple orchards on a commercial scale were made in different parts of Jackson County. The principal varieties were Ben Davis, Jonathan, Missouri Pippin, York Imperial, and Gano. These orchards have been irregular in their bearing, netting the owner a profit about one year out of every three or four. Most of them have a neglected, unkempt appearance, and some are being removed. Practically no planting on a commercial scale has taken place since 1890. Many small orchards for family use are being maintained, and small plantings of apples, peaches, and pears are occasionally made. Strawberries, blackberries, raspberries, and grapes are grown to a considerable extent in the vicinity of Kansas City. Large quantities of nursery stock are grown at Lees Summit, Independence, and Greenwood. Potatoes, melons, and garden truck are grown in the East Bottoms in the northern part of Kansas City and on the uplands near Independence

[1] See Bulletin No. 87, issued by the Experiment Station, and Corn Growing in Missouri, issued by the State Board of Agriculture.

[2] Circular No. 43, Wheat Growing in Missouri, issued by the Agricultural Experiment Station at Columbia, Mo., treats of this subject.

and Kansas City. The growing of cut flowers in this vicinity is also becoming an important industry.

In 1873, according to the Eighth Annual Report, Missouri State Board of Agriculture, improved lands were held at from $25 to $50 an acre, while good, unimproved timbered land could be bought at prices ranging from $8 to $25. Good prairie land commanded a somewhat higher price. At present the best farming lands are held at prices ranging from $75 to $150 an acre. Rough and stony land is cheaper. Near Kansas City, where speculative values are to be considered, land in small tracts is held at prices ranging from $250 to over $1,000 an acre.

SOILS.

The soils of Jackson County may be divided into three broad groups, the loess soils found principally in the northern half of the county, the residual soils in the southern half, and the alluvial soils, which occur as bottom lands along the Missouri River and all the smaller streams of the area.

The loess soils, where occurring typically, are easily recognized by their yellowish-brown or dark-drown color, their rather peculiar rounded topography, by the frequent occurrence of deep V-shaped gullies or washes, by the absence of rock outcrop, except along the larger streams, by the peculiar manner in which the materials stand in perpendicular walls when eroded, and by the uniformity of the entire soil section, both in color and texture.

There is evidence, in the form of glacial till and foreign bowlders, that the ice sheet which covered all of north Missouri and northeastern Kansas during glacial times extended south approximately to the Missouri River. The loess formation covers the southern part of the glacial area and in most places extends some distance south of it. In many places the loess rests upon glacial till, but near its southern limit it is usually superimposed upon limestone or shale or upon the soil formed from these rocks. In Jackson County evidences of till are found in only a very few places.

The loess is supposed to be wind-blown material from the glaciated areas. It was formerly no doubt deposited in a fairly uniform sheet over the entire surface covered by this deposit, the sheet being thickest along its northern boundary, thinning out toward the south. Erosion has carried much of it off the slopes, so that now the thickest beds are usually found on the tops of the ridges and in the valleys at the bottoms of the slopes.

The loess is fairly uniform in color and texture throughout the soil section and is very productive. Where the surface has been cut

away, leaving the subsoil exposed, this, after weathering for a short time, becomes easy to cultivate, and if properly handled can in a short time be made as productive as the surface soil.

In the northern part of the area covered by the loess the soil is a light yellowish brown in color and has a rolling and in places a badly dissected topography. Farther from the river and from the other stream courses the surface is more nearly level and the soil darker in color. Soil of the first type is called the Knox silt loam, that of the second type the Marshall silt loam.

Underlying the loess soils in Jackson County are several alternating limestone and shale beds from which the residual soils of the county have been formed. These beds dip slightly to the west and north, so that the top or more recently deposited beds are found in the northwest part of the county, while the oldest or lowest beds come to the surface in the southeastern part. A cross section of the

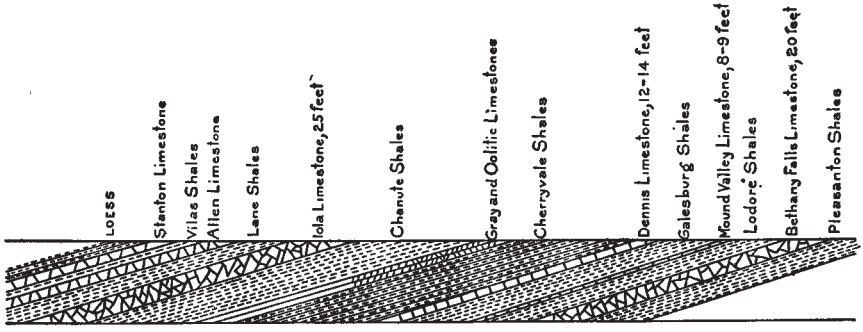

FIG. 36.—Cross section of Jackson County from northwest to southeast.

county from the northwest to the southeast corner would show alternating shale and limestone beds, the older beds appearing at the surface in the southeast, but disappearing under the more recent beds to the northwest. The accompanying ideal cross section (fig. 36) illustrates this and gives the beds in the order in which they occur.[1]

The higher of these beds are covered by loess and play but a small part in the formation of soils. The lower beds outcrop along the larger streams and their tributaries, so that the area of each soil depends directly upon the topography and extent of the drainage systems.

The shale beds vary in color from light yellow, grayish yellow, or drab, through many shades of brown and reddish brown to black. In hardness they vary from soft, micaceous, and in places sandy

[1] Valuable assistance in the study of the geology of Jackson County was given by Rev. John Bennett, of the Missouri Geological Survey.

shale to almost slate. Similarity exists in the ease with which they break down and form soils when exposed to the weather, and they are rarely seen except when protected by overlying limestone beds or eroded by streams or roads.

Four principal limestone beds are of importance in the formation of soil in this county, the Iola, the Dennis, the Mound Valley, and the Bethany Falls. All belong to the Upper Coal Measures of the Carboniferous age. Like the shale beds, the limestone beds vary in depth in different parts of the area, but this rock is much more persistent and uniform in character throughout the area than is the shale. Further, they withstand erosion, to which fact is due the rough character of the country bordering the streams. When a stream has cut through a limestone bed it works down rapidly into the shale, cutting back and undermining the limestone, which drops down in large masses. This accounts for the steep bluff lines along the larger streams and their tendency to swing out and make elongated basinlike valleys where small tributaries join them.

The Iola limestone, where exposed in the bluffs at Kansas City, has a thickness of about 25 feet. The Dennis, which is easily recognized by the thin, persistent beds of chert found in it, varies from 12 to 14 feet in thickness. The Mound Valley, recognized by the thin slabs into which it weathers, is 8 or 9 feet thick, and the Bethany Falls has a thickness of about 20 feet. A thin limestone bed of two 14-inch layers occurs in the Pleasanton shale below the Bethany Falls, and other thin beds occur both above and below the Iola. The heavy beds named are, however, the principal soil-forming and also the principal outcropping beds. The Iola limestone caps the upland west of the Big Blue River and the extreme summit of the ridge which extends from Lees Summit to the north and west. It also caps the ridge separating the drainage of Sniabar Creek from that of the Little Blue River. The principal outcrop, however, except in the western part of the county, is that of the Bethany Falls. This formation, with its persistent uniform bed, its spotted appearance, and peculiar bumpy form of weathering, is easily recognized and is the most distinct formation of the area. It appears as an escarpment along the small streams in the southeastern part of the county, along tributary streams of Sniabar Creek and the Little Blue River. In this section of the area it is the principal outcropping formation and the rock used most extensively in Jackson County for road making. Along the Big Blue River and its tributaries it outcrops low down, the Iola appearing above it.

The Mound Valley is separated from the Bethany Falls by a thin layer of soft and in places sandy yellowish shale, while the Dennis is separated from the Mound Valley by a still thinner shale bed. Outcrops of these two limestone beds often occur together. The

principal outcrops of this kind are found around the headwaters of Big Creek near Greenwood; in sections 29 and 30, southeast of Lonejack; in sections 20 and 29, 2 miles northeast of Blue Springs; and in section 7, 1 mile south of Independence. Small outcrops of each of these beds occur separately in many other places in the county.

Owing to the tendency of the shale and thin limestone beds to break down readily and distribute the soils formed from them down the slopes, it has been impossible to separate the soils on a strictly geological basis, nor is it necessary to do this, since the soils are sufficiently alike to be placed in groups each of which includes soils from several different beds.

The residual soils of Jackson County have been divided into two main groups or series—the Crawford soils, derived principally from limestone, and the Summit soils, derived principally from shales.

The alluvial soils of this area also fall into two series, those found in the flood plain of the Missouri River, known as the Sarpy soils, and those found in the valleys of the smaller streams called the Wabash soils.

The following table gives the names and extent of the various soil types of the county:

Areas of different soils.

Soil	Acres.	Per cent.	Soil.	Acres.	Per cent.
Crawford silt loam	91,712	25.1	Sarpy fine sandy loam	5,568	1.4
Eroded phase	5,696		Sarpy clay loam	4,416	1.1
Summit silt loam (brown phase)	75,968	19.6	Sarpy silty clay	3,648	.9
Knox silt loam	57,152	14.7	Crawford stony clay loam	3,328	.9
Wabash silt loam	32,384	10.8	Riverwash	2,368	.6
Colluvial phase	9,600		Wabash loam	1,792	.5
Marshall silt loam	32,704	8.4	Sarpy fine sand	1,280	.3
Summit silty clay loam	29,568	7.6	Buckner loam	320	.1
Summit clay loam	17,984	5.2	Total	388,480	.....
Eroded phase	2,240				
Wabash clay	4,992	2.8			
Light phase	5,760				

SUMMIT SERIES.

The Summit soils, derived largely from Coal Measure shales, but also influenced by thin beds of limestone and in places mixed with loess soils, are the principal residual soils of the area. The Summit silt loam, brown phase, is the most important soil of this series.

SUMMIT SILT LOAM, BROWN PHASE.

A large area of the Summit silt loam was mapped in the earlier survey of Bates County, Mo. In the present area the soil is not

typically developed, but an important phase is found which will be described in the following paragraphs.

The brown phase of the Summit silt loam consists of a smooth, micaceous chocolate-brown or reddish-brown silt loam of fairly uniform color and texture to a depth of from 16 to 20 inches, where it becomes slightly lighter in color and heavier in texture. In general appearance and in crop value this soil resembles very closely the brown phase of the Marshall silt loam and in the northern part of the area covered by it is modified somewhat by thin deposits of loess.

This type is very widely distributed over the county. A large body of it surrounds the Summit silty clay loam and another large body extends along the divide between Little Blue River and Sniabar Creek. Each of the larger bodies have numerous offshoots extending over the divides between the smaller streams. In nearly all cases this type has been confined to the soils derived from shales which outcrop above the Bethany Falls limestone. In a few places soils occurring below this formation have been included.

The larger part of this soil was formerly timbered, the growth consisting of white and red oak, walnut, elm, locust, and hackberry, with some hickory. Some of it in the southwestern part of the county was prairie.

When of good depth and well drained it is suited to all crops of the area. The estimated average yield for the last 10 years is given by seven farmers who use this type, as corn 43⅓ bushels, and wheat nearly 19 bushels per acre. Oats yield from 30 to 40 bushels. Clover does well and alfalfa can be grown. As a whole it is the most productive residual type in the area.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Summit silt loam, brown phase.

Mechanical analyses of Summit silt loam, brown phase.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
24321	Soil	0.1	0.3	0.5	1.1	19.7	57.7	20.5
24322	Subsoil	.0	.6	.5	1.1	16.6	55.7	25.1

SUMMIT SILTY CLAY LOAM.

The soil of the Summit silty clay loam is a smooth, uniform, silty clay loam, dark gray at the surface when dry, but black when wet. It contains considerable quantities of very fine quartz sand. At a depth of from 15 to 18 inches the soil passes rather gradually into a heavier silty clay subsoil mottled yellow, gray, and brown in color. Near the zone of transition to the heavier subsoil small iron concre-

tions are usually found. When in good moisture condition this soil is friable and easily cultivated, but it puddles and afterwards bakes readily when handled too wet. Poorly drained areas often become very black and heavy, approaching gumbo in texture. As a whole this soil is somewhat colder and later than the brown phase of the Summit silt loam which surrounds it.

This type occupies the almost level tops of the divides, the main body of it stretching from near Lonejack westward through Cockrell and Lees Summit, thence south, and out of the county southwest of Greenwood. Small isolated areas occur north of this belt. Since this soil occupies the more nearly level and poorer drained portions of the upland, the dark color is probably due in part to the higher percentage of organic matter. It is also due in some places to a layer of black shale, which comes to the surface in this zone.

The area covered by the Summit silty clay loam was prairie at the time of the settlement of the country. The soil is well adapted to corn, timothy, bluegrass, cowpeas, and small grains. Clover is grown on it, but to a less extent than on the brown phase of the Summit silt loam. When seasonal conditions are favorable, it produces excellent crops; but it does not stand drought, especially on the slopes where the surface soil is shallow.

An estimated average yield of crops, furnished by nine farmers who cultivate this type, is: corn 38 bushels and wheat 15 bushels per acre. Oats yield about 35 bushels and timothy and clover nearly 2 tons per acre.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this type:

Mechanical analyses of Summit silty clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
24325	Soil	0.0	0.6	0.5	0.7	1.9	70.4	25.6
24326	Subsoil	.0	.6	.4	.6	.7	71.4	26.1

SUMMIT CLAY LOAM.

The Summit clay loam occurs principally in the eastern part of the county, covering the greater part of the area drained by Sniabar Creek. In color, general appearance, and crop value this soil approaches rather closely the Summit silty clay loam. The latter is prairie soil, while this type was formerly timbered.

The Summit clay loam consists of a black or very dark brown, silty, micaceous clay loam, which at a depth of from 15 to 18 inches is underlain by a stiff, mottled yellow and gray silty clay or clay

loam. In low places, and especially where seepage water comes to the surface, areas of heavy black sticky soil have been developed. These "gumbo" spots, which are in many places a clay in texture, are usually too small to be shown separately on the soil map and have been included with the clay loam. The largest of these occurs south and southwest of Oak Grove.

The Summit clay loam has resulted entirely from the weathering of the Pleasanton shale. The black color is due in part to the layer of black slatelike shale which lies immediately below the Bethany Falls limestone. This type was originally timbered with several varieties of oak, elm, hickory, locust, and some walnut.

Although fairly good crops are grown on the better areas of this type the soil as a whole is less productive than the loess soils or the brown phase of the Summit silt loam. The estimated average yield for the past 10 years of six farmers who handle this soil is, corn 38 bushels and wheat 17 bushels per acre. Some clover is produced on this type, but not so much as on the soils above mentioned.

Summit clay loam, eroded phase.—In the southeastern part of the county, along the streams which flow into Big Creek and also in a few places farther north in the drainage basin of Sniabar Creek, areas of this soil occur in which the surface soil is light gray or yellow, is rather heavier in texture than the typical soil, and in many places supports dense growths of scrubby post oaks. In the areas to the north these oaks often occur in pastures in circular clumps.

This soil is not very productive, but can be built up by the use of cowpeas and clover. Corn yields from 20 to 35 bushels, wheat 10 to 15 bushels, and oats about 25 bushels per acre.

Crawford Series.

The Crawford series includes residual limestone soils of the prairie regions, characterized by dark-brown to reddish-brown surface soils and reddish-brown to red subsoils. While derived from limestones the soils usually contain only a small percentage of lime, differing very materially in this respect from the soils of the Houston series, occurring in the Cretaceous black prairies of the Coastal Plain. They are productive and well adapted to general farming.

Crawford silt loam.

The Crawford silt loam, in addition to having the largest area and widest distribution of any soil in the county, has also the greatest range in soil variations and in crop value. It is largely of limestone origin, although influenced to a considerable extent by material derived from thin shale beds. The principal limestone beds from which it is derived are the Bethany Falls and the two thinner beds,

the Mound Valley and the Dennis, which outcrop above it. In the western half of the county some areas of soil derived from the Iola limestone and from thinner beds have been included, although they are not quite typical, being yellower in color, slightly heavier in texture, and usually less productive.

The Crawford silt loam varies in color from yellowish to brick red and in places is a reddish brown. In texture the surface varies from a fine sandy loam or loam to silt loam, the percentage of very fine sand in all cases being rather large. At a depth of from 10 to 15 inches this grades into a stiff silt loam or silty clay loam, deeper red in color than the surface. The subsoil may extend to a depth of 3 feet or more or may rest upon the underlying limestone at a less depth. Much of this type of soil is of good depth, but the areas in which it occurs are usually more or less broken by rock outcrops. It is usually drained by numerous small streams which have cut down to the limestone beds or have cut through them and are now bordered by perpendicular ledges varying in height from 20 to 40 feet. These outcrops and ledges interfere seriously with the use of much of this land for farming purposes. The soil immediately above and below these ledges and quite close to the outcrops which occur on the slopes produces good crops of grass. This broken land is used largely for pasture. Occurring as it does in the more broken areas, the Crawford silt loam is readily damaged by erosion. Where it occurs on ridges and has been thoroughly leached it resembles very closely in color and texture the Knox silt loam, though not so productive a soil.

This type was formerly heavily timbered, and much of it, especially the rougher parts, is still uncleared, the forest growth consisting largely of white oak, walnut, elm, hackberry, basswood, ash, and locust. When the soil contains chert from the Dennis bed, black and red oak with some hickory predominate. Where the soil is shallow, full of chert, or mixed with large amounts of shale, post oak, bur oak, and blackjack oak predominate.

Where of good depth this may be considered one of the better soils of the area, especially suited to fruits, small grains, clover, and tobacco. Corn on the best portions of it will average 35 or 40 bushels per acre, wheat 18, and oats 35 bushels. White Burley tobacco yields from 1,200 to 1,500 pounds per acre. Cowpeas should be grown more extensively on this type and alfalfa should be given a thorough trial.

Crawford silt loam, eroded phase.—The eroded phase of the Crawford silt loam is a yellowish-brown heavy silt loam extending to a depth of from 8 to 12 inches, where it grades into a yellowish mottled silty clay, which is uniform to a depth of 3 feet or more or rests on shale or thin limestone beds. It occurs principally on the rather steep slopes of the streams which empty into the upper course of

the Little Blue River and into the Big Blue River in the southwest part of the county. The surface soil is often very shallow and dries out rapidly. It supports a good growth of bluegrass and white clover and is used principally for pasture.

The following table gives the results of mechanical analyses of samples of the typical soil and subsoil of this type:

Mechanical analyses of Crawford silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
23670	Soil	0.0	0.1	0.2	0.4	3.4	73.3	22.3
23671	Subsoil	.0	.2	.1	.3	5.2	73.7	20.3

CRAWFORD STONY CLAY LOAM.

The Crawford stony clay loam comprises those areas of residual limestone soil which are so filled with fragments of chert, limestone, and shale that they are of little value except for the small amount of pasture which they afford. The soil is usually a clay loam or clay. A few small areas in which the surface silt loam has been removed, leaving the red clay loam or clay, usually of shallow depth, exposed, have been included with this soil.

The type is cultivated only to a very small extent and rather scant yields are obtained. Many small areas not shown on the soil map have been included with the Crawford silt loam. These can usually be readily recognized by their stony and cherty appearance, often by their bright red color, and especially by the timber growth, which consists very largely of scrubby black oak, post oak, and blackjack oak.

WABASH SERIES.

The Wabash soils are alluvial in origin and composed of material washed from the residual and loess soils of the area. In color they vary from dark gray to black and in texture from light silt loam to clay. Since the areas covered by these soils are confined to the stream bottoms, many of the areas are subject to overflow and some need protection from overflow and artificial drainage.

WABASH LOAM.

Near Atherton, where the Little Blue River enters the Missouri River bottoms, a soil type not found in other parts of the area and very limited in extent occurs. It is a black, smooth, rather heavy loam, extending to a depth of about 15 inches, where it rests upon a heavy, tenacious gray clay of puttylike appearance reaching to a

depth of 3 feet or more. A peculiarity of the soil is the fact that the sand content is almost entirely very fine sand. The position of this soil would seem to indicate that it is due to deposition from the flood waters of the Little Blue checked by back water from the Missouri.

This soil gives good yields of corn, wheat, and clover, and should be found well adapted to potatoes, garden truck, and berries.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this type:

Mechanical analyses of Wabash loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
23668	Soil	0.0	0.0	0.2	2.2	47.4	32.1	18.0
23669	Subsoil	.0	.1	.2	1.4	8.8	44.3	45.3

WABASH SILT LOAM.

The Wabash silt loam is the most important soil type of this series, both in extent of area and in crop value. It occurs as long narrow strips in the valleys of all the streams within the area, usually occupying the entire valley of the smaller streams and the higher and better drained portions of the valleys adjacent to the larger streams.

In color the typical soil varies from gray to black at the surface, usually becoming somewhat lighter in color below 15 or 18 inches. In texture it varies from a very fine sandy loam to a heavy silt loam, the lighter phase usually occurring next to the stream and grading into a heavier soil away from it. It is smooth, friable, and easy to cultivate. The subsoil is usually heavier than the surface soil, although in some places the light soil extends to a depth of 3 feet or more. In places along the lower course of the Little Blue River and its tributaries and along the abandoned valley of this stream the soil is extremely black in color and the subsoil differs but little from the surface soil. In many places this black silt loam is found on a terrace several feet higher than the adjacent streams. This terrace probably indicates a higher stage of the Missouri River, the back waters of which may have deposited this soil.

In the abandoned valley of the Little Blue River this soil seems to be very closely related to the Marshall silt loam, which is adjacent to it, and in the lower valley of the Big Blue between Swope Park and Sheffield there are several areas in which the soil is made up almost entirely of loess, the surface being level and very slightly modified by overflow from this stream.

The Wabash silt loam usually occurs in narrow strips which do not permit of large field areas. It lacks uniformity of texture and much of it is subject to overflow. Aside from these features it is one of the most productive soils of the area. It is usually well supplied with organic matter, which furnishes humus and nitrogen. It is easily cultivated, and is suited to a wide range of crops, especially to corn, garden truck, and alfalfa. Corn on the better phases will yield 40 or 50 bushels, wheat 18 or 20, and potatoes 100 to 200 bushels per acre.

Wabash silt loam, colluvial phase.—Along the drainage courses of the small streams, especially where these extend out into the nearly level areas, a strip of soil often of sufficient extent to be shown on the soil map is found. This is not a true alluvial soil, but has been formed by the wash from adjacent slopes. Often gravity helps in its accumulation, through the sliding or creep of the soil particles during periods of wet weather and when moved by cultivation. The wind also plays an important part in filling up these low areas with material blown from the adjacent soils. This wash is usually darker in color and richer in organic matter than the adjacent soils.

During normal or dry seasons these areas of wash usually produce the best crops, but in wet seasons crops on them are often injured by excess of moisture. When properly drained this phase may also be considered one of the most productive soils of the county, suited to corn, clover, and alfalfa.

The following table gives the results of mechanical analyses of typical samples of the soil and subsoil of this type:

Mechanical analyses of Wabash silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
23666	Soil	0.0	0.0	0.0	0.7	18.4	69.3	11.2
23667	Subsoil	.0	.6	.6	.8	21.9	63.3	13.0

WABASH CLAY.

The Wabash clay is typically developed over only a part of its area in Jackson County. A light phase of the soil occurs, and the area of the phase is greater than that of the typical soil, the respective measurements being 5,760 and 4,992 acres. The typical soil is a dark bluish gray or black clay of uniform color and texture to a depth of from 15 to 18 inches, where it grades into a gray clay slightly lighter in texture, reaching to a depth of 3 feet or more.

This soil is very heavy and sticky and difficult to cultivate when wet. When dry it cracks badly, the fissures often extending to the subsoil.

The Wabash clay is found in the low, poorly drained portions of the valleys and has been formed by deposition from overflow and backwater, the currents of which could carry only the finer silt and clay soil particles. Standing water has also helped in breaking down the soil into still finer particles.

The principal areas occur along the lower courses of the Big Blue and Little Blue Rivers and in the abandoned valley of the latter stream.

Much of this soil is not cultivated. Some of it is covered with wild grasses and used for pasture or hay and some is well set with bluegrass and white clover. In the vicinity of Lake City several areas are cultivated. Although this soil is refractory and difficult to handle it can be greatly improved by following the recommendations made for the light phase.

Wabash clay, light phase.—The Wabash clay, light phase, usually occupies an intermediate position between the silt loam lying along the streams and the typical clay soil usually found near the bluff. It consists of a dark-gray clay containing a little more sand than the typical soil. It is, however, heavy and difficult to cultivate. When handled wet it puddles and when dry it clods and bakes badly. At a depth of from 12 to 18 inches it grades into a soil of slightly lighter color and seemingly of heavier texture, but this is due very largely to the displacing of the very fine sand of the surface soil by silt, the clay content of the subsoil usually being slightly less than of the surface soil.

The light phase is cultivated to some extent, but the results are often discouraging, especially on the heavier areas and during seasons of more than normal rainfall. Two steps are necessary if this soil is to be brought to a high state of cultivation—thorough drainage and the improvement of the physical condition of the soil. Drainage conditions can be improved in some cases by a system of open ditches, but the best results can not be obtained until a comprehensive system of tile drains is installed; in many cases this would necessitate protection from overflow. The soil structure can be improved by the use of coarse manure and by plowing under crops of clover and cowpeas. Cultivation will also improve the type in this respect. Where the soil has become sour or acid, as it has in places, through long-continued marshy conditions, this can be corrected by the addition of lime or ground limestone. Corn is best suited to this soil when first brought under cultivation, but when in a fair state of tilth it will be found well adapted to the production of other crops.

The following table gives the results of mechanical analyses of samples of both the typical soil and the light phase:

Mechanical analyses of Wabash clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
Typical:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
23682.....	Soil.....	0.0	0.9	0.4	0.9	0.5	54.3	43.2
23683.....	Subsoil.....	.0	.6	.3	1.0	1.3	58.1	38.6
Light phase:								
23672.....	Soil.....	.0	.9	.8	1.6	18.4	46.3	32.0
23673.....	Subsoil.....	.0	1.4	.5	.7	1.0	69.0	27.2

SARPY SERIES

Soils of the Sarpy series are the result of deposition from flood waters of the Missouri River and as found in this area are characterized by their light-brown or tan color, by the rather sudden transition of the soil into a subsoil of lighter texture, in which mica particles and fine sand are conspicuous, and by their tendency to occur in thin layers of varying texture, each of these representing a period or a stage of overflow.

They are confined to five bodies of rather limited extent, the combined area of all being only about 23 square miles, or 14,912 acres, and a large part of this is subject to annual or periodic overflows, which not only interfere with crops and improvements but often entirely change the character of the soil itself. These areas consist of about 6 square miles in Kansas City, known as the East Bottoms, about 2½ square miles north of Courtney, 7 square miles at Atherton, 3 north of Sibley, and 4½ square miles at Levasy. Of these the most important agriculturally is at Levasy, the greater part of this being above ordinary stages of high water and also protected by its indented position from heavy erosion by the river. The East Bottoms at Kansas City are most valuable on account of their position within the city limits and also on account of the use made of the higher portions for gardening purposes. The north part of the bottoms at Atherton and almost all of the Courtney and Sibley bottoms have been seriously injured by flood waters and the river is constantly making heavy inroads upon them. Unless vigorous steps are taken to protect them from its cutting the indications are that before many years these points will be entirely cut away.

In classifying those portions of the bottom lands which are subject to frequent overflow from the Missouri River it has been necessary to include with each soil areas not representative of the type as a whole, but corresponding more nearly with it than with any

other type. The Sarpy soils are in a state of transition. A flood period may leave a sandy area covered with several inches of silt or clay, or the process may be reversed and a silty area may be covered with sand. Were these areas protected from overflow, even the sandier of them could soon be built up and made productive.

The lower parts of these wet areas are in most places covered by a dense growth of small willows and cottonwoods and have been indicated on the soil map by marsh symbols.

SARPY FINE SANDY LOAM.

The most important type of the Sarpy soils is the fine sandy loam. It consists of a smooth, micaceous, yellowish-gray fine sandy loam, usually slightly heavier in texture below 5 or 6 inches. At a depth of from 12 to 20 inches the fine sandy loam grades rather abruptly into a fine sandy loam of lighter texture or into sand. This may continue to a depth of 3 feet or more or may in turn be underlain by a heavier soil. Thin alternating layers of soil of different texture are common in the subsoil.

Where high enough to be well drained this soil is easily cultivated and productive. It produces fair crops of corn, small grains, clover, and alfalfa, but is especially suited to the growing of melons and garden truck. In the East Bottoms at Kansas City this constitutes the principal trucking soil, and one crop of vegetables follows another in quick succession throughout the growing season. In these gardens large quantities of manure are used, and returns are sufficiently large to enable the owners to obtain an annual cash rental of from $15 to $20 an acre.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this type:

Mechanical analyses of Sarpy fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
23678	Soil	0.0	0.0	0.0	36.8	36.3	18.0	9.1
23679	Subsoil	.0	.0	.0	12.9	58.7	21.8	6.9

SARPY CLAY LOAM.

The Sarpy clay loam consists of a yellowish-gray or light-brown clay loam usually slightly darker in color than the fine sandy loam. It is smooth and micaceous and usually becomes heavier with increased depth. The soil ranges from 12 to 20 inches, below which is a very light silt loam or fine sandy loam. Thin soil layers of different texture are common in the subsoil.

This is the best corn, small grain, and alfalfa soil of the Sarpy series. Corn yields 40 or 50 bushels or more and wheat 18 to 25 bushels per acre.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this type:

Mechanical analyses of Sarpy clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
23676	Soil	0.0	0.0	0.6	2.0	25.9	41.0	30.6
23677	Subsoil	.0	.0	.1	.1	9.0	68.8	22.0

SARPY SILTY CLAY.

The Sarpy silty clay is closely associated with the Wabash clay, but on account of its lighter subsoil has better drainage and is a more productive soil. It consists of a yellowish-brown silty clay, darker in color than the clay loam. This is fairly uniform in color and texture and extends to a depth of from 20 to 30 inches, where it is underlain by a micaceous silt, fine sandy loam or fine sand. Alternating thin layers of different textures are common in the subsoil, and the lighter subsoil is in places entirely wanting. Much of this type is too wet to be cultivated. Where well drained it produces fair crops of corn and small grains, though it is difficult to handle.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this type:

Mechanical analyses of Sarpy silty clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
24339	Soil	0.0	0.1	0.2	0.6	3.4	64.8	30.5
24340	Subsoil	.0	.0	.1	.3	8.3	76.4	14.9

SARPY FINE SAND.

The Sarpy fine sand is a smooth, fine micaceous sand which occurs in elongated strips or ridges, usually near the river, and also covers considerable portions of the areas subject to frequent overflow. In its present condition it is of little agricultural value, but if covered by and mixed with a heavier soil it could be made productive.

MISCELLANEOUS.

KNOX SILT LOAM.

The Knox silt loam comprises the lighter colored areas of loessial soil. It consists of a light yellowish brown, smooth, micaceous silt

loam, containing a high percentage of very fine sand. At a depth of from 16 to 18 inches the surface soil grades into a subsoil having a very much higher percentage of silt and some clay. From 30 inches down this subsoil usually becomes slightly lighter in texture. Iron pipes and thin dark-brown bands, very slightly cemented, also occur in places in the subsoil.

Where timbered the surface soil is darker colored than the subsoil, but in the cultivated fields the color for the entire soil section is almost uniform. Owing to the fact that the subsoil of the Knox silt loam when exposed to weathering can be brought to a state of good tilth and productiveness, some farmers claim that it can not be injured by neglect and hard usage. No more serious mistake than this could be made, for owing to its rolling topography and to the peculiar texture of the soil which makes it easy of erosion, it is rapidly injured whenever neglected. Not only are deep V-shaped washes cut too deep to be checked, but the "clay points" with their scant crops show where the surface soil with its larger amount of humus has been removed by sheet washing.

Examination of the loess soils of eastern Nebraska by the agricultural experiment station shows that while the subsoils to a great depth are supplied with potash and lime and have a fair supply of phosphoric acid, they are deficient in nitrogen,[1] so that the problem of maintaining the fertility of these soils is largely one of supplying organic matter which includes humus and nitrogen. This can be done by using manure and by growing and plowing under legume crops.

This is a friable, easily cultivated, well-drained soil and as a whole is the best alfalfa, clover, fruit, and gardening soil of the area. When well supplied with nitrogen and humus it produces good crops of corn and wheat and, in fact, any crop suited to the climate. In other counties it is used extensively for tobacco, yields of from 1,200 to 1,800 pounds of White Burley being obtained.

Wheat yields about 18 bushels per acre on the average, corn from 40 to 50 bushels, oats 35 bushels, and potatoes from 75 to 150 bushels. Alfalfa yields three or four cuttings of from three-fourths ton to over 1 ton at each cutting, and clover two cuttings. Larger yields of all of these crops are often obtained.

This type was formerly heavily timbered with white oak, hard maple, walnut, elm, and other trees which grow best in a deep soil, but is now practically all cleared.

MARSHALL SILT LOAM.

The soil of the Marshall silt loam is a smooth, uniform, slightly micaceous silt loam or loam containing considerable amounts of

[1] Agricultural Experiment Station of Nebraska. Vol. XXII, Art. I.

very fine sand. At a depth of about 16 inches the soil grades into a heavy silty subsoil, which continues to a depth of 40 inches or more, but seems to become slightly lighter in texture below 30 inches. In color it varies from a light chocolate-brown to almost black, this darker color extending to a depth of from 12 to 16 inches, but gradually giving place to the lighter colored, more yellowish brown of the Knox silt loam. This soil is of good depth and fairly easy to cultivate, but if handled when too wet becomes rather hard and tends to clod. This tendency, however, can be largely prevented by the addition of organic matter in the form of manures or legume crops plowed under.

The loess soils extend across the north part of the county in a broad, irregular belt, which varies in width from about 4 miles on the east side to more than twice that along the Kansas line. In this belt the Marshall silt loam occupies the more level, less eroded areas, while the lighter colored, more eroded Knox silt loam occupies a strip extending south from the Missouri River and the breaks and eroded areas surrounding the more level areas of Marshall soils.

The line of demarcation of the Knox and Marshall silt loams with the limestone and shale soils toward the south is extremely indefinite. The color, texture, and general appearance of the soil derived from the thin beds of limestone and from the lighter colored shales, especially where they occur along ridges and have been well leached, are almost identical with the lighter colored loess soils, while the heavier, darker colored shale soils resemble as closely the darker colored loess or Marshall soils. When soils unlike in origin but resembling each other closely in appearance are mixed as these are, along their boundaries, their separation becomes largely a question of determining which is the predominating soil. For this reason many areas closely resembling loess soils will be found far south of the limits of these soils as given on the map. It is believed that the loess deposits do influence the soils as far south as the valley of the Sniabar, north of Oak Grove, Grain Valley, and Blue Springs. In general, the most typical areas of the loess soils of both types occur along the north side of the loess belt and become heavier in texture, slightly different in color, and not quite so productive toward the south.

At no place in this area was a heavy impervious subsoil similar to that underlying this type in some parts of the State encountered.

The Marshall silt loam is the best small-grain, clover, and corn soil in the area. In the vicinity of Kansas City, Independence, and Raytown it is used extensively for truck gardening and flower growing. Wheat averages about 20 bushels per acre, although larger yields are often obtained—corn 40 to 60 bushels, oats 35 to 40 bushels, and clover two cuttings of a ton or more at each cutting.

The following table gives the average results of mechanical analyses of samples of the soil and subsoil:

Mechanical analyses of Marshall silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
23680, 24327.....	Soil.....	0.0	0.1	0.2	0.4	2.5	73.4	23.3
23681, 24328.....	Subsoil.....	.0	.1	.2	.4	2.9	69.1	27.3

BUCKNER LOAM.

In the abandoned valley of the Little Blue River several elongated mounds or ridges, evidently the remnants of former stream terraces, occur. The long axes of these ridges have the same trend as that of the valley, and the ridges range from 5 to 20 feet above the floor of the valley proper. The tops of these ridges, and especially of the smaller mounds, are very sandy, owing possibly to the assortment and accumulation through wind action, the soil varying from sand to sandy loam. The slopes of these mounds and the larger areas are heavier in texture and have been mapped as a loam.

The type as mapped in this area consists of a dark-brown, almost black, loam containing numerous medium, well-rounded quartz sand grains. Below 12 or 15 inches this grades into a lighter brown soil, much lighter in texture, which extends to a depth of 3 feet or more.

This soil, except where too sandy, is fairly productive and well suited to all crops of the area. Owing to its limited extent it is an unimportant type. The type is of alluvial origin.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this type:

Mechanical analyses of Buckner loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
4315.....	Soil.....	0.0	5.5	20.6	11.9	2.2	41.5	17.7
4316.....	Subsoil.....	.0	7.3	30.1	18.4	3.9	25.4	14.7

RIVERWASH.

Riverwash, as mapped in this area, consists of medium to coarse, sharp, almost pure quartz sand. In its present condition it is of no agricultural value.

DRAINAGE AND MOISTURE CONSERVATION.

Two classes of Jackson County soils need artificial drainage, the residual soils where seepage water often follows a shale or limestone bed coming to the surface on the slopes, and the wet areas of the alluvial soils.

In the residual soils when seepage water comes to the surface and is left to find its own way to a watercourse, small areas of wet, boggy soil, which soon becomes heavy in texture, are formed. This is the origin of many of the small patches of gumbo found in these soils. Such areas are not only of low productiveness, but interfere seriously with the cultivation of the adjacent drier soils. A line of tile laid along the slope above these areas with sufficient fall to carry off the water will in a short time greatly improve the soil conditions in these areas. Much drainage of this kind has been installed in Jackson County and has in almost all cases proved effective. More work of the same kind is needed.

Many wet areas of the alluvial soils are now of little use except for pasture, and that usually of a poor quality. If protected from overflow and thoroughly tile-drained they would prove strong productive soils. The possibility of tile drainage proving effective in these heavier soils is often questioned. Mechanical analyses of these soils, however, show the clay to contain from 45 to 58 per cent of silt and the light phase of the clay to contain over 65 per cent of silt and very fine sand, the subsoil containing slightly more silt than the surface soil. Tile, properly laid in such a soil, should prove effective.

Moisture conservation should receive more attention in this area. There are few seasons when the cultivated crops do not, during some period of growth, suffer from lack of sufficient moisture. This is especially true of corn and of wheat in the fall, yet even in the driest years the annual rainfall is enough to more than supply all demands if it could be held until needed. To a great extent this can be done by deep plowing, thus making a reservoir in which to catch the moisture. This should be followed in the case of intertilled crops by frequent shallow cultivations to reduce loss by evaporation and hold the moisture in the soil until needed by the growing plants.

The yield of corn can often be very materially increased by shallow cultivation between the rows after it has become too high for ordinary cultivation. The best implement for this purpose is a small, short-toothed, one-horse harrow which will go between the rows. When the surface mulch formed by such a cultivation is compacted by a rain it must be restored by another cultivation.

When wheat is to follow oats or wheat the ground should be plowed as soon after the crop is harvested as possible, and each day's

plowing followed by a thorough harrowing at once to conserve the moisture.

Both in the spring and late summer, the period when the ground plows easily can be greatly lengthened by thoroughly disking it when in good condition before beginning to plow. This not only lessens the labor of plowing, but greatly improves the seed bed and reduces the amount of cultivation necessary afterwards.

ALKALI AND SOIL EROSION.

In many parts of Jackson County, and especially in the eroded areas which occur around the edge of the darker colored shale soils, small areas of unproductive soils occur known locally as "alkali spots." They vary from a few feet to several yards in width, and are usually lighter in color than the surrounding soil. In some places they are entirely bare and in others have a growth of weeds or grass which usually differs somewhat either in size or variety from that found on the surrounding soils. Where these spots occur in a cultivated field the crop is usually poor or a complete failure. If the spot is covered by a surface layer of better soil the crop often grows fairly well at first, but soon begins to show signs of distress and is the first to suffer in case of drought.

An examination of this soil shows it to be very dry and hard and almost impervious to water. Where cut into by ditches it shows the cubelike structure found in gumbo. Small lime concretions are often abundant where this soil has weathered, and a chemical examination shows it to contain a very small percentage of sodium bicarbonate. This does not usually occur in sufficient quantities to be directly injurious to plant growth, but is believed to be harmful through its influence in changing the soil structure. These areas often occur where the heavy layers of subsoil underlying the black soils are exposed by erosion, and further erosion increases their area.

This condition is a rather difficult one to deal with and no very satisfactory remedy has been found. The best plan where a field containing these spots is to be used for cultivated crops is to apply manure in large quantities and plow it under, mixing with the soil very thoroughly. Green crops plowed under will also be found of assistance. When these spots occur on a slope or near a small slough where it is possible to put in a brake or check of some kind which will catch the soil as it is washed from the higher ground they can sometimes be covered with good soil.

In an area so thoroughly dissected as this the problem of preventing serious injury from erosion is a most important one. If fields are neglected for a short time gullies too deep to be crossed by farm machinery and in many cases too deep to be checked without great

labor and expense are soon cut. This, although the most evident result of erosion, is not the most important one. Gullies are often filled and erosion of this kind checked by farmers who fail to appreciate the loss of their best soil over large areas of their fields by sheet erosion, by which is meant the removal of soil particles from the entire surface over slopes of sufficient steepness. No records have been obtained to determine the rapidity of such erosion, but from the amount of material which is carried into the small washes and which is found deposited at the foot of long slopes it is believed that the material removed from the slopes in a field in a single season often exceeds the amount necessary to produce a crop. "Clay points" and unproductive "breaks" are the results of such work.

Erosion can be largely checked by deep plowing and cultivation, which will increase the water-holding capacity of the soil; by cultivation along instead of down the slopes; by avoiding the use of the steeper slopes for cultivated crops continuously, and by protecting the surface with a growing crop as much of the year as possible. Rye or wheat sown in corn after the last plowing will do much to prevent erosion during the following winter, furnishing in addition winter and spring pasture and a green crop to plow under. Manure thoroughly mixed in the soil will help to check erosion through increasing its tilth and water-holding capacity.

Ditches once started can be checked by filling with brush, straw, or other material securely fastened down. The ditch banks and the soil collected by such checks should be heavily seeded, redtop being the best grass of this region for such purposes. When gullies have become too deep to be checked by such means a heavy planting of black locust trees in the gulley and along the slope will sometimes prove effective.

SUMMARY.

Jackson County is one of the leading agricultural counties of Missouri and contains the second largest city in the State.

In transportation facilities and extent of rock roads it surpasses all other counties.

Its agriculture consists of general farming combined with stock raising, but in addition to this much attention is given to poultry raising, trucking, and various other forms of intensive farming.

Farm practices as a whole are fairly good, but there is room for much improvement in the adoption of better crop rotations, the wider use of legume crops, especially cowpeas, the more systematic use of manure, and more thorough cultivation.

Drainage, protection from overflow, conservation of soil moisture by cultivation, and methods of preventing soil erosion should all

receive attention if the soils of the county are to be brought into their highest state of productiveness.

The soils of Jackson County may be divided into three broad groups—the loess soils, the residual limestone and shale soils, and the alluvial soils.

Each of these groups contains deep, well-drained, productive soils suited to a wide range of crops, but the last two groups also contain soils which are much less productive, and thorough investigation should precede any investment in farm lands.

In general the loess soils and the sandy loams and silt loams of the alluvial group may be considered the best truck, melon, and alfalfa soils; the loess and the red limestone soils the best small-grain, fruit, and tobacco soils; and the darker colored shale soils the best bluegrass, white clover, timothy, and corn soils.

The price of farm lands has advanced materially in the last few years and now ranges from $75 to over $150 an acre for the better lands. Rough and stony land can, in some parts of the county, be bought for less. Within a few miles of Kansas City much higher prices are asked.

NRCS Accessibility Statement

This document is not accessible by screen-reader software. The Natural Resources Conservation Service (NRCS) is committed to making its information accessible to all of its customers and employees. If you are experiencing accessibility issues and need assistance, please contact our Helpdesk by phone at 1-800-457-3642 or by e-mail at ServiceDesk-FTC@ftc.usda.gov. For assistance with publications that include maps, graphs, or similar forms of information, you may also wish to contact our State or local office. You can locate the correct office and phone number at http://offices.sc.egov.usda.gov/locator/app.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

U.S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF.

SOIL MAP

MISSOURI
JACKSON COUNTY SHEET

UNIVERSITY OF MISSOURI
AGRICULTURAL EXPERIMENT STATION
F.B. MUMFORD, DIRECTOR
CURTIS F. MARBUT, IN CHARGE SOIL SURVEY

R. 33 W. | R. 32 W. | R. 31 W. | R. 30 W. | R. 29 W.

T.51 N. | T.50 N. | T.49 N. | T.48 N. | T.47 N.

SOIL PROFILE (3 feet deep)

- Summit silt loam (Brown phase): Sil / Sic
- Summit silty clay loam: Sil / Sic
- Summit clay loam: Cl / Sic
- Eroded phase: Sil / Sic
- Wabash loam: L / Sic
- Wabash silt loam: Sil / Sic
- Colluvial phase: Sil / Sil
- Wabash clay: C / C
- Light phase: Cl / Sic
- Sarpy fine sand: Fs
- Sarpy fine sandy loam: Fsl / Fsl / Fsl
- Sarpy clay loam: Cl / Sic
- Sarpy silty clay: Sicl / Si
- Crawford silt loam: Sil / Sicl
- Eroded phase: Sil / Sic
- Knox silt loam: Sil / Sic
- Marshall silt loam: Sil / Sic
- Buckner loam: L / Sl
- Crawford stony clay loam: Cl

LEGEND

Sil	Silt loam
Sic	Silty clay
Cl	Clay loam
C	Clay
L	Loam
Fs	Fine sand
Fsl	Fine sandy loam
Sicl	Silty clay loam
Si	Silt
Sl	Sandy loam

LEGEND

- Summit silt loam (Brown phase) — S
- Summit silty clay loam — Ss
- Summit clay loam — Sc
- Eroded phase — Sc
- Wabash loam — Wl
- Wabash silt loam — W
- Colluvial phase — W
- Wabash clay — Wc
- Light phase — Wc
- Sarpy fine sand — Sf
- Sarpy fine sandy loam — Sl
- Sarpy clay loam — Scl
- Sarpy silty clay — Ss
- Crawford silt loam — Cs
- Eroded phase — Cs
- Knox silt loam — K
- Marshall silt loam — Ms
- Buckner loam — Bl
- Crawford stony clay loam — Cc
- Riverwash — R
- Swampy areas

J. E. Lapham, Inspector in charge.
Soils surveyed by
A. T. Sweat of the U.S. Department of Agriculture
and H. Knaekopf and J. E. Dunn
of the University of Missouri.

Scale 1 inch = 1 mile
1 ½ 0 1 2 3 4 miles

Field Operations
Bureau of Soils
1910